Using Oral Histories and Participatory Mapping to Understand the Biological Impacts and Resilience of Fishermen to Red Tides on the West Florida Coast

Usando Historias Orales y Mapeo Participativo para Entender los Impactos Biologicos y Resiliencia de los Pescadores a las Mareas Rojas en la Ccosta Occidental de la Florida

Utilisation des Histoires Orales et de la Cartographie Participative pour Comprendre les Impacts Biologiques et la Résilience des Pêcheurs aux Marées Rouges sur la Côte Ouest de la Floride

MATTHEW MCPHERSON[1]*, MANDY KARNAUSKAS[1], SUZANA BLAKE[1], ADYAN RIOS[1], SKYLER SAGARESE[1], and MICHAEL JEPSON[2]
[1]*NOAA Fisheries Southeast Fisheries Science Center,*
75 Virginia Beach Drive, Miami, Florida 33149 USA.
**matthew.mcpherson@noaa.gov*
[2]*NOAA Fisheries — Southeast Regional Office*
263 13th Avenue South, St. Petersburg, Florida 33701USA.

EXTENDED ABSTRACT

Introduction

Red tide is a harmful algal bloom that is caused by a brevetoxin producing dinoflagellate called *Karenia brevis*. Although red tides have been a feature of life along in the Gulf of Mexico since the time of the Spanish colonists, the number of long-lasting red tide events appears to have been increasing in recent years. Furthermore, the level of environmental impact is exacerbated by red tides of longer duration and extent. In addition to the obvious fish kills and water quality issues, stakeholders report having observed extensive habitat damage, the disruption of fish migration patterns and increasingly delayed recovery of fish populations following recent red tide events. In turn, these environmental impacts affect ecosystem services and disrupt local economies, resulting in decreases in tourist visitation, disruption of commercial fisheries, declines in the sale of local seafood, loss of aquaculture harvests, decreases in real estate values and impacts on public health due to the toxic fumes emitted by the algae. These issues can generate additive and potentially synergistic effects that can have far-reaching impacts on commercial and recreational fishermen and coastal communities.

A series of summer 2018 workshops led by NOAA's Southeast Fisheries Science Center (SEFSC) with fisheries stakeholders on the southwest Florida coast highlighted serious issues regarding the multifaceted impacts of red tide. In response to the concerns reported by workshop participants, the SEFSC collaborated with NOAA's Atlantic Oceanographic and Meteorological Laboratory (AOML) to develop a red tide response plan to document impacts on fish and fishing communities, understand bloom ecology and to learn and prepare for future red tide events.

Among other methods, the response plan included an initiative to systematically explore local ecological knowledge (LEK) regarding red tides with fishermen using oral histories and participatory mapping. The LEK assessment contributed to the accomplishment of red tide response plan goals through the following activities:

i) Documenting red tide locations, frequency and severity over time and space,
ii) Documenting impressions of how red tides/blooms develop and their impact on different fish populations and habitats,
iii) Identifying possible ecological signals and stakeholder-driven hypotheses of red tide event occurrence and severity, and
iv) Documenting the adaptation strategies fishermen have employed in the face of red tide events.

Methodology

Some 58 oral history interviews were conducted with current or retired commercial and for-hire fishermen in key fishing communities along the Gulf Coast of Florida that had historically experienced relatively high commercial landings or for-hire fishing activities as well as red tide events (Karnauskas et al. 2019). Social scientists and biologists from both the SEFSC and NOAA's Southeast Regional Office (SERO) participated in this study. The majority of interviews were conducted using an interdisciplinary approach in which a social scientist worked in tandem with a fisheries biologist or ecologist. This approach ensured that the full breadth of questions and clarifications were asked to obtain relevant information on both biological and socio-economic impacts and helped generate observations about the interconnections between natural and socio-economic systems. Using two interviewers also allowed for a division of labor, with one asking questions and the other taking notes. Researchers did not identify a specific number of interviews to be conducted in each community during the planning phase of the project. Rather, interviews in each community continued until researchers felt each subsequent interview was providing largely redundant information regarding major red tide events in that area (Karnauskas et al. 2019). All of the interviews were recorded, and waivers were obtained from fishermen so that the recordings can eventually be added to the NMFS Voices from the Fisheries oral history collection (https://www.voices.nmfs.noaa.gov).

A subcomponent of the oral histories interview was a participatory mapping activity in which the fishermen were asked to draw the spatial extent of red tide events they had witnessed on nautical charts. Based on their best recollection, they were also asked to describe the biological and

socio-economic impacts of each red tide event they identified on the maps. The types of information requested included:

i) The exact year (or approximate dates) in which the event occurred,
ii) The impacts on fish and marine life they witnessed,
iii) The duration and severity of the event,
iv) The recuperation time of the affected fisheries and habitat,
v) The ways that these events affected their fishing practices and livelihoods,
vi) Survival strategies,
vii) Health impacts, and
viii) Impacts on overall community well-being (Karnauskas et al 2019). The participatory maps were entered into a geodatabase and are being used to analyze the relative intensity and impacts of red tide events along the west coast of Florida over time. The oral history interviews are being transcribed and coded for further analysis.

Results

Initial analysis of the oral history interview data indicates that fishermen can provide very accurate information regarding the location of red tide events and other ecological phenomena. For example, the participatory mapping exercise showed that LEK participatory maps drawn by fishermen overlapped with data points gathered by the State of Florida of areas of high concentrations of *Karenia brevis* (Karnauskas pers. comm.). Furthermore, there appears to have been a loss of resilience with the 2017 - 2018 red tide event which did not occur with other blooms of shorter duration, extent and intensity. This was true with regards to both biological and socio-economic resilience. In the words of one fisherman, for example:

…in the past a lot of species fared well with the red tide, but this year nothing, there was not one species that was not affected. About 200 sharks would seek refuge a couple of months ago in this small pocket here, into the canal system. The next day they were all dead. We never seen sharks there before

Similarly with regards to the loss of socio-economic resilience:

The problem is that people don't want to buy fish from this area. I have about 10 – 12 fishermen that work for me. During the winter I have as much as 100 fishermen. Well this year I have 2. They went off and got other jobs…

The oral history process also proves to be a very effective way of obtaining testable hypotheses. For example, in the words of another fisherman:

...so is this red tide changing the way these fish have been doing things for thousands and thousands of years? Absolutely! ... The mullet spawns usually during the red tide season. All summer they come up to the red tide and go right back; as soon as they sense the red tide. They come to the bridge at the pass here and then turn right back. They usually travel up to the river and then return with the tide. However, when they are ready to spawn, she's going to go right there and die. I've watched millions die like that…

The oral history information was also used to inform a recent red grouper stock assessment (SEDAR 2019). Relevant information was extracted from each of the oral histories and was quantified to compare the recent 2017-2018 event to previous events in terms of severity, recovery time, temporal extent and species killed. The 2018 event was ranked by most fishermen as devastating across regions and as lasting longer than previous red tide events (Karnauskas et al 2019). Furthermore, the oral histories and data from fisheries independent surveys suggest that the 2018 event had a large impact on the red grouper population. As a result, the SSC recommended setting the OFL and ABC levels for red grouper under the assumption that the 2018 red tide event was similar in magnitude to the 2005 red tide event, which was estimated to have killed off some 30% of the stock. In practical terms, this meant that the SSC recommended setting the OFL and ABC for red grouper at lower levels to mitigate risks related to red tide impacts on the population (Sagarese, *Personal communication*).

The oral history information is also being analyzed to understand the adaptive strategies of fishermen in the face of red tide events and, similarly, the factors that contribute to the levels of vulnerability and resilience of fishermen in the face of red tide events. A very preliminary analysis already has already provided some interesting insights into adaptation strategies and resilience factors.

As mentioned previously, red tides were identified as a regular occurrence that fishermen have to cope with in the Gulf of Mexico. The impact of red tides on fishing and aquaculture activities depends on the location, extent and duration of a red tide event in a given area of the Gulf. Red tide event intensity was categorized on a 3-part scale (minor, major, devastating) based on general descriptions or terms used to describe the events (Karnauskas et al. 2019). In terms of adaptation and resilience, the minor or low/major red tide events were largely regarded as nuisances that fishermen are able to cope with by strategies such as: "fish in it and through it"; "letting traps soak longer"; fishing around the red tide using "trial and error"; temporarily shifting their fishing locations "from offshore to inshore, north or south"; and/or temporarily changing their target species. Shellfish aquaculture is also of economic importance to many fishing communities in west Florida, and minor or low/major events of short duration generally also only result in temporary delays in the harvest

of clams and shellfish related to state harvesting prohibitions during elevated levels of *Karenia brevis*.

The more severe events place much more pressure on the fisheries and although many fishermen and fishing businesses are able to struggle through it, for others it leads to a complete breakdown in resilience and abandonment of the fishing enterprise. Severe events also illustrate the levels of creativity, flexibility and persistence that fishermen display in an effort to maintain their businesses in the face of a crisis. For example, when faced with major and devastating events, fishermen often must travel very far from their home ports and normal fishing grounds to find areas to fish; they may also try to fish in deeper areas and target a wide variety of different species. However, this kind of strategy often greatly increases the costs of fishing due to the needs to invest in more fuel, to purchase and change gear, and to purchase permits and fishing quota. Other fishermen reported shifting from commercial fishing to running fishing charters, going even so far as running fishing and "photo tourism" charters in the "backcountry" (Everglades).

As resilience begins to break down, some fishermen stop fishing and find temporary jobs. Fishermen interviewed cited temporary employment as construction or electrical workers, Uber drivers, clerks in Home Depot, charter fishermen, and ecotourism guides. Some travel to other areas of the country to find work on fishing boats as captains or crew. The fishermen that eventually are able to return to fishing often will employ not just one of these strategies but multiple strategies in order to feed their families and cover the fixed costs of their fishing business as they ride out the crisis..

At the point when resilience breaks down completely, many fishermen are no longer able to feed their families and sustain the fixed costs involved in maintaining their unused vessels and equipment or become frustrated with the daily struggles of trying to keep their fishing operations afloat. Many older fishermen say they decided it was a good time to retire. Other younger fishermen decided to sell their vessels and equipment and leave the industry for good to pursue a different career. Many shellfish aquaculture operations go out of business because devastating, long lasting red tide events result in the complete loss of their harvest due, not to increased mortality, but rather because over time the product grows beyond a marketable size.

A more detailed analysis of the oral histories data is required to pinpoint the most important factors and conditions that affect fishermen's resilience in the face of major and devastating red tide events. A better understanding of these major resilience factors can be important in helping fisheries managers formulate policies to increase resilience to red tides. A preliminary analysis of the oral history data suggests that resilience factors include the following:

i) Restrictiveness of regulations (e.g. IFQs, permits) with regards to effort switching,
ii) The ability and willingness to make additional effort and assume costs involved in switching gear and fishing practices to target different species.
iii) The distance of home ports to alternate fishing grounds and the increase in trip costs as trips move further from homeport,
iv) Early fishery closures due to effort shifts into alternate species (e.g. crabs to kingfish),
v) Financial means of individual fishermen (savings and debt levels of their businesses and households),
vi) Personal characteristics of fishermen including factors such as age and health levels, time fishing, and other business or job skills,
vii) Household factors and social capital including family support and support networks, and
viii) The compound effects of disasters that affect the fisheries (e.g. a hurricane followed closely by a major red tide event).

Conclusion

Preliminary analysis of the data from this LEK assessment has proved useful in informing the red grouper stock assessment process and in beginning to document the biological, economic and social impacts of red tides on west Florida communities. There has been great value in having biologists and social scientists work together in all phases of this project. However, we are still in the early stages of the analysis of the oral history and other data collected as part of this project. The next steps will involve completing the digitization of participatory maps and conducting a more in-depth analysis of the historical spatial distribution of red tides as well as finishing the coding of the written transcripts from the oral history interviews and using text analysis techniques to conduct a more systematic analysis of interview data to better accomplish the LEK assessment objectives. Finally, the results of this project will continue to be shared broadly with fisheries stakeholders, fishing communities, fisheries managers and the scientific community.

KEYWORDS: Participatory research, red tide, Florida

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